

PATENT SPECIFICATION



Application Date: May 16, 1944. No. 9366/44.

576,864

Complete Specification Left: May 4, 1945.

Complete Specification Accepted: April 24, 1946.

PROVISIONAL SPECIFICATION

Improvements relating to Finned-Tube Heat Interchange

Apparatus

We, SERCK RADIATORS LIMITED, a British Company, of Warwick Road, Greet, in the City of Birmingham, 11, and ALFRED MATTHEW MARTIN, a British 5 Subject, of the Company's address, do hereby declare the nature of this invention to be as follows:—

This invention relates to heat interchange apparatus of the kind comprising 10 the combination of rows of thin metal tubes and transverse thin metal fin plates through which the tubes are inserted, the tubes forming passages for liquid, and the spaces between the fin plates forming 15 passages for air. In particular the invention relates to apparatus of the said kind as used for cooling the jacket water, or cooling or warming the lubricating oil, of internal combustion engines on air 20 craft and road vehicles. To increase the effectiveness of the air stream it is already known to form on the fin plates at positions between the tubes, protuberances which serve to promote turbulence in the 25 air stream, but the advantage obtainable by this device is to some extent neutralised (and may sometimes be wholly neutralised) by the diminution of the air flow on account of the increased resistance caused by the said protuberances. 30

The object of the present invention is to provide a heat interchange apparatus of the kind aforesaid having air turbulatising protuberances on the fin plates so 35 shaped and arranged as to offer a minimum of obstruction to the air flow.

The invention comprises the combination of a plurality of rows of thin metal tubes of elongated cross section, and 40 arranged parallel with each other, the tubes in any row being staggered in relation to the tubes in the adjacent row or rows, thin metal fin plates arranged parallel with each other and transversely 45 to the tubes, and at least one pair of spaced-protuberances of shallow and rounded form situated between each adjacent pair of tube surfaces, the space between each pair of protuberances being 50 situated directly opposite the adjacent forward edge of a tube in the next row.

In one manner of carrying the inven-

tion into effect for use as an engine water cooler, or an oil cooler or warmer, we may employ thin metal tubes of narrow elliptical cross section, but preferably we employ tubes of stream-lined cross section. The fin plates which are situated at right angles to the tubes are formed with holes through which the tubes can be inserted, 55 and (as hitherto) the edges of the holes are flanged to provide adequate contact area between the tubes and fin plates. The tubes are arranged parallel with each other in rows, and are spaced at a suitable distance apart. Moreover the tubes in any one row are staggered in relation to those in the adjacent row or rows, and are preferably so disposed that they lie 60 centrally between the adjacent tubes. 65 Further, we preferably do dispose the tubes that the front and rear edges of the tubes in an intermediate row or rows lie slightly within the spaces between the tubes in the adjacent rows. 70

According to our invention we form on each of the portions of the fin plates lying between the tubes in each row, at least one pair of shallow elongated protuberances having rounded surfaces. These are 80 arranged parallel with each other and are spaced at equal distances from each other and from the adjacent tube surfaces, and the space between the protuberances is in line with the edge of a tube in the next 85 row. Preferably these protuberances are of stream-line form, both in the horizontal and vertical plane of section, so that the widest and highest part of each is at its forward end. 90

By so shaping and disposing the protuberances, we not only obtain the desired turbulence with a minimum of resistance to air flow, but we also arrange that the portion of the air stream flowing in the 95 venturi-like passage between each pair of protuberances shall impinge on the forward edge of the tube in the next row and thus further promote the effectiveness of the action of the air stream on the tube 100 surfaces.

It will be understood that in the construction above described, the length of the protuberances is less than that of the

BEST AVAILABLE COPY

portion of the air passage formed by each pair of adjacent tube surfaces. But the invention is not restricted to this example. For some purposes, it may be necessary or 5 desirable to arrange the staggered tube rows so that the edges of the tubes in the intermediate rows do not enter the spaces between the other tubes. In this case the

lengths of the protuberances is increased and is made about equal to the front-to- 10 back width of the adjacent tubes. Further other details may be modified to suit different requirements.

Dated this 15th day of May, 1944.
MARKS & CLERK.

COMPLETE SPECIFICATION

Improvements relating to Finned-Tube Heat Interchange Apparatus

We, SERCK RADIATORS LIMITED, a 15 British Company, of Warwick Road, Greet, in the City of Birmingham, 11, and ALFRED MATTHEW MARTIN, a British Subject, of the Company's address, do hereby declare the nature of this invention 20 and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to heat interchange 25 apparatus of the kind comprising the combination of rows of thin metal tubes and transverse thin metal fin plates through which the tubes are inserted, the tubes forming passages for liquid, and the 30 spaces between the fin plates forming passages for air. In particular the invention relates to apparatus of the said kind as used for cooling the jacket water, or cooling or warming the lubricating oil, of 35 internal combustion engines on aircraft and road vehicles. To increase the effectiveness of the air stream it is already known to form on the fin plates at positions between the tubes, protuberances 40 which serve to promote turbulence in the air stream, but the advantage obtainable by these protuberances is to some extent neutralised (and may sometimes be wholly neutralised) by the diminution of the air 45 flow on account of the increased resistance caused by the said protuberances. Moreover, it has been proposed in Specification No. 471,553 to make the protuberances of streamline form.

50 The object of the present invention is to provide a heat interchange apparatus of the kind aforesaid having air turbululating protuberances on the fin plates so shaped and arranged as to offer a minimum of 55 obstruction to the air flow.

The invention comprises the combination of a plurality of rows of thin metal tubes of elongated cross section, and arranged parallel with each other, the 60 tubes in any row being staggered in relation to the tubes in the adjacent row or rows, thin metal fin plates arranged parallel with each other and transversely

to the tubes, and spaced-protuberances of shallow and rounded form provided on the 65 fin plates between each adjacent pair of tube surfaces in a row and arranged with a space between them directly opposite to an edge of a tube in an adjacent row.

In the accompanying sheet of explanatory drawings:—

Figure 1 is a sectional side elevation, and Figure 2 a sectional plan, of a part of an engine radiator, or an oil cooler or warmer, embodying the invention, Figure 75 1 being taken on the line 1—1 of Figure 2.

Referring to the drawings, we employ thin metal tubes *a* of narrow elongated (elliptical or stream-lined) cross section, 80 and we insert these tubes through holes in fin plates *b* which are situated at right angles to the tubes, the edges of the holes in the fin plates being formed (as hitherto) with flanges *c* to provide adequate contact area between the tubes and fin plates. The tubes *a* are arranged parallel with each other in rows, and are spaced at a suitable distance apart. Moreover the tubes in any one row are staggered in relation to those in the adjacent row or rows, and the tubes in the intermediate row or rows preferably lie in planes passing centrally through the spaces between the tubes in the adjacent rows. Further, we 90 preferably so dispose the tubes *a* that the front and rear edges of the tubes in the intermediate row or rows lie slightly within the spaces between the tubes in the adjacent rows.

In carrying the invention into effect as shown, we form on each of the portions of the fin plates *b* lying between the tubes in each row, at least one pair of shallow elongated protuberances *d* having rounded 105 surfaces. These protuberances are arranged parallel with each other and are spaced at equal distances from each other and from the adjacent surfaces of the tubes *a* in the row, and the space between the 110 protuberances is in line with the edge of a tube in the next row. Preferably the protuberances are of stream-line form,

both in the horizontal and vertical plane of section, so that the widest and highest part of each is at its forward end.

By so shaping and disposing the protuberances, we not only obtain the desired turbulence with a minimum of resistance to air flow, but we also arrange that the portion of the air stream flowing in the venturi-like passage between each pair of protuberances shall impinge on the forward edge of the tube in the next row and thus further promote the effectiveness of the action of the air stream on the tube surfaces.

15 It will be understood that in the construction above described, the length of the protuberances is less than that of the portion of the air passage formed by each pair of adjacent tube surfaces. But the invention is not restricted to this example. For some purposes, it may be necessary or desirable to arrange the staggered tube rows so that the edges of the tubes in the intermediate rows do not enter the spaces 25 between the other tubes. In this case the lengths of the protuberances is increased and is made about equal to the front-to-back width of the adjacent tubes. Further other details may be modified to suit 30 different requirements.

Having now particularly described and

ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Heat interchange apparatus of the kind specified, comprising the combination of a plurality of rows of thin metal tubes of elongated cross section, and arranged parallel with each other, the tubes in any row being staggered in relation to the tubes in the adjacent row or rows, thin metal fin plates arranged parallel with each other and transversely to the tubes, and spaced-protuberances of shallow and rounded form provided on the fin plates between each adjacent pair of tube surfaces in a row and arranged with a space between them directly opposite to an edge of a tube in an adjacent row. 50

2. Heat interchange apparatus as claimed in Claim 1, in which a pair of the spaced-protuberances are provided between each adjacent pair of tube surfaces.

3. Heat interchange apparatus as claimed in Claim 1, in which the protuberances are shaped and arranged substantially as described and as illustrated in the accompanying drawings. 55

Dated this 30th day of April, 1945.
MARKS & CLERK.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1946. Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies, price 1s. 0d. each (inland) 1s. 1d. (abroad) may be obtained.

BEST AVAILABLE COPY

[This Drawing is a reproduction of the Original on a reduced scale.]

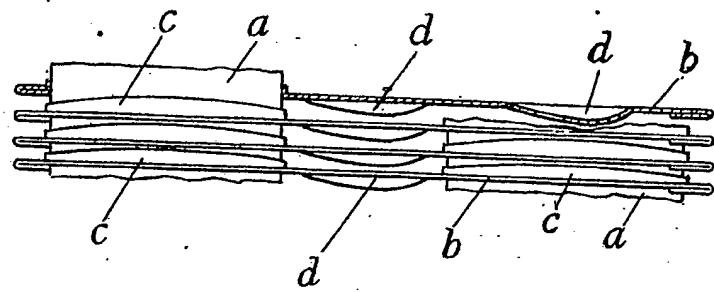


Fig. 1

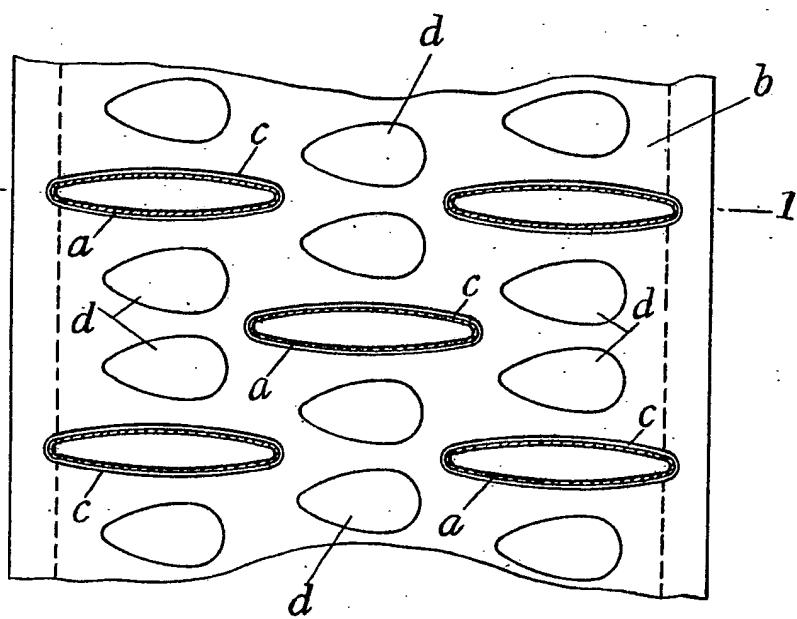


Fig. 2